

THE MEANING
and MAGIC
of
WINDOWS



By
MATTHEW LUCKIESH
D. Sc., D. E.



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Dr. Matthew Luckiesh, in addition to serving as Director of the Lighting Research Laboratory of General Electric Company at Nela Park, Cleveland, is regarded throughout the world as an outstanding authority on lighting.

He is the originator of radically new concepts of seeing. The researches which he has directed have developed the science of seeing which is revolutionizing both viewpoint and attitude throughout many activities of a civilization built largely upon seeing. Out of his works has arisen a world-wide movement that is bringing to mankind an adequate concept and knowledge of seeing.

Dr. Luckiesh possesses an astonishing capacity for work and versatility of talent.

Combined with scientific attitude and achievement are other personalities—dreamer, philosopher, realist, humanitarian, nature lover, and author. In his fluent speech and writing, one or more of these personalities often enhances the cold facts and logic of the scientist. His knowledge of the world—of people and their reactions and needs—gives to his writings a clearness and depth too often missing in addresses on fundamental research.

In his researches, Dr. Luckiesh has shown that human beings see not only with eyes and light but with their bodies and minds. "They are," he tells you, "human seeing machines." This new approach has opened an entirely new vista of research and has stimulated a broader view in various practices.

THE MEANING *and* MAGIC *of* WINDOWS

Windows serve in such seemingly obvious and simple ways that too generally they are taken for granted. Their very commonplaceness tends to conceal their services to civilization and the depths of their meaning to *human* beings. We are lulled into easy acceptance without adequate understanding or careful planning to enjoy to the full their potentialities. However, we are in the midst of a great awakening. Advanced design in architecture, and in interior decorations and furnishings, is at last leaving behind the primitive era of indoor dimness. The parade of progress has already entered a new era of luminosity in keeping with enlightenment. Even casual observation of the new exteriors and new interiors leads easily to the conclusion that a Luminous Era has arrived.

We treasure many of the products and details of older period styles. Traditions in architecture, in construction and in interior decoration and furnishing are persistent.

Nevertheless, a great revolution is well under way. Simplicity is displacing heavy ornamentation. Functional considerations are successfully challenging art merely for art's sake. Perhaps art itself is being extended in meaning. Dingy interiors are a mark of the past.

Dark-stained wall panelings, ceilings heavy with ornament and light-absorbing colors, scanty glass areas, and other features of civilized dungeons are giving way to luminosity. Light that merely makes darkness visible belongs to the past.

Among man-made products glass ranks high in its

service to civilization. Its characteristics appeal to the visual sense and the esthetic sense, to the physical being and the human spirit.

In this new period of enlightenment glass areas are being extended. Much of the glass is wisely fixed in position without hampering ventilation. Additional services of glass are emphasized in new products and their uses. Translucent glasses provide luminous walls — decorative as well as useful. Large window areas, properly located, let light in and *let vision out*.

New glass products for window-areas provide the advantages of storm windows in winter and aid air conditioning in summer. Old excuses for small windows are now invalid and new reasons for modern glass products have been created in the progress from bare necessity to convenience and comfort. As a consequence it is practicable to extend glass areas. It has always been desirable.

A new interest in daylight is evidenced by the fact that this new luminous era is characterized by an intensive use of louvers. The old blinds with their movable shutters are relegated to a role of mere ornament. Venetian blinds with their adjustable louvers are replacing shades. When necessary they temper the direct light from the sun or sky without shutting out too much light as shades do. But this use of louvers is not confined to such equipment. Already the idea is being incorporated into building structures.

In subtropical countries where the new luminous era in architecture and decoration is replacing the old

traditional structures, great vertical louvers of reinforced concrete are functional elements of structure. They act as great shutters shielding the interior from too powerful direct sunlight while admitting the relatively cool light from the sky.

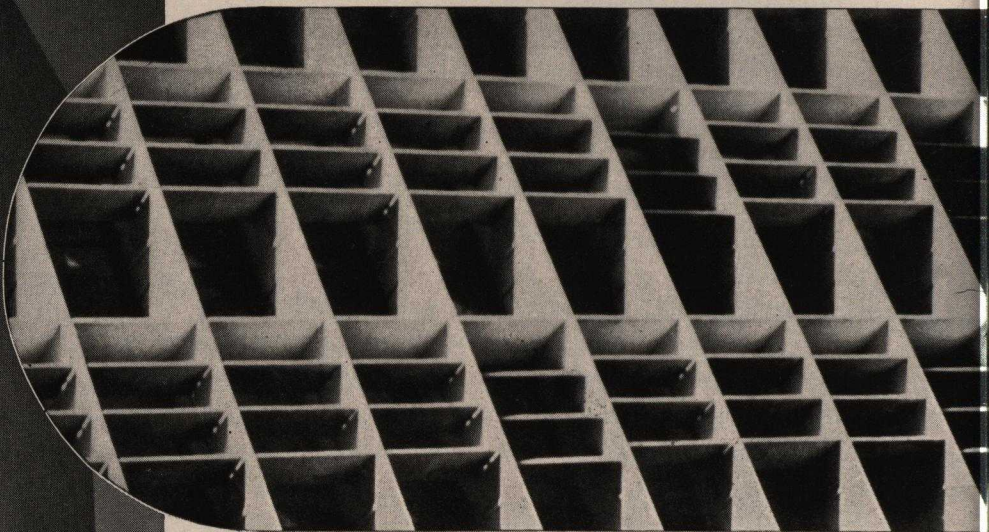
This idea has many possibilities through the tropics and subtropics but it should be considered even in the temperate zones for certain exposures of schools and other buildings. The old saw-tooth roof of industrial plants is a forerunner of this idea, but it is applicable only to single-story buildings or to the upper story.

Many variations of louvers will occur to those who would control sunlight and utilize daylight to the best advantage. These new ideas combined with new glass products enliven our interest in daylight which is a prominent characteristic of the new era of luminous interiors.

Tradition and indifference die hard. To understand fully how windows serve us we must sense something of the evolution of civilization from its beginning a million years ago, for their importance ex-



Sweeping expanses of window walls, protected from summer sun by wooden visors such as characterize Solar-type dwellings, provide an abundance of natural daylight in the new Schuckl Canning Company office building in Sunnyvale, Calif. Architects: Wurster and Bernardi.



Above—close-up of recessed windows of Ministry of Education and Public Health, Rio de Janeiro, Brazil, completed in 1943. Fixed concrete fins at sides and at top and bottom of each window protect against direct sun at various hours of the day and year while permitting a flood of natural light to enter all portions of the building. Many such structures have been built in the trend to daylight engineering in South American countries. Photos courtesy Museum of Modern Art, New York.



"After mere openings to admit light came . . . man-made glass not only to let light in but to let vision out."—Luckiesh.

tends beyond the physical being and its need for light to serve sight. They effect inner realms of the human mind, imagination and spirit. To comprehend fully the vast services and complex meaning of windows we must glimpse the evolution of human beings measured by a billion years or more.

These are great distances in time but they are quickly spanned by the imagination guided by a few highlights. Along that vista of time we find the reasons why we are *human* beings and as such are overwhelmingly dominated by light and sight—and *seeing*.

Hand in Hand with Civilization

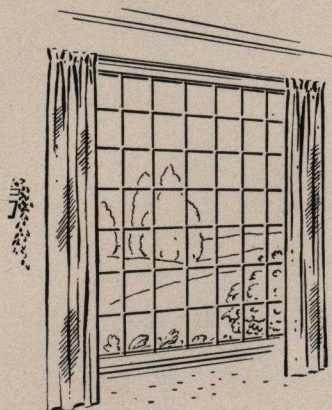
A million years ago, or thereabouts, primitive beings ceased to drift with the current of Nature. The outdoor natural world was at once beneficent and indifferent. It gave life and it took lives indiscriminately.

Primitive beings with scanty knowledge, gained the hard way through accidental experience, came indoors into caves and later into crude huts. Unknowingly this act was the first declaration of independence by beings destined to become *human* beings.

True, it was a crude beginning inspired by self-preservation which was the first incentive and goal. Necessity was the mother of invention. Windows—bare openings to begin with—let light in to serve sight.

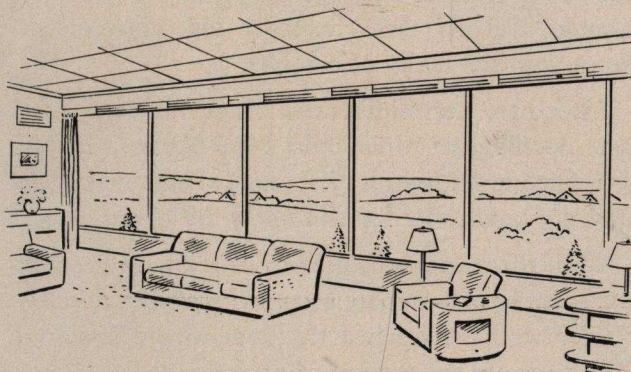
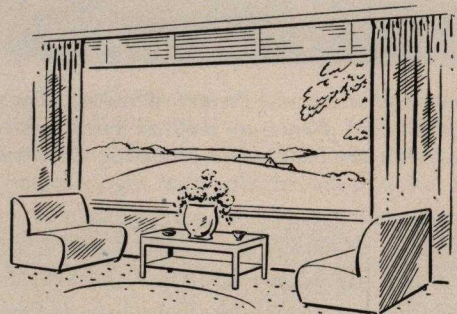
Civilization has grown almost infinitely more complex. Today it cannot be described briefly but it can still be defined simply. At least in a material sense, civilization is the substitution of a controlled artificial world for an uncontrolled outdoor natural world.

We are still Nature's beings in the last analysis. As a consequence we bring indoors some of the beneficence of the outdoors. As knowledge increases we gain greater control over Nature's secrets and forces



Small window openings gave way to larger ones, and the trend now is to glaze the bigger areas with larger individual panes of glass.

Today the Picture Window is popular—large expanses unbroken by small panes, to provide unhampered vision. ➡



"Old excuses for small windows are now invalid . . . it is practical to extend glass areas. It has always been desirable."—Luckiesh.

and steadily improve upon a capricious Nature in our indoor world.

The new-born safety of the cave or crude hut provided a byproduct of time to think, to plan and to



Dramatic utilization of the Picture Window idea has been made by Architect H. W. Johanson in this Solar-type dwelling. Venetian blinds and drapes are utilized when needed or desired, but a colorful, stimulating blending of the outdoors and indoors has been achieved while providing an abundance of natural light for more cheerful interiors—improved interior vision and vision to the outside—both highly important to the eyes.

invent. Family life began and thus the very foundation of civilization was laid. Refinements gradually extended beyond sheer necessity into convenience, thence into the realm of comfort.

After bare necessities came crude luxuries. After mere openings to admit light came Nature's materials refined to let light in. Eventually came man-made glass not only to let light in *but to let vision out*.

With the continuous growth of refinement of living, luxuries of yesterday become necessities of today. Finally we have reached the stage where invention often becomes the mother of necessity.

Windows, whether mere openings or covered with thin translucent skin or other material, made the artificial world *practicable* within the limits of bare necessity in reasonable climates. They made the indoor world *endurable*.

Glass windows with their multiple services not

only make interiors practicable and endurable but where used wisely and adequately they make our indoor world *enjoyable*. They go far beyond their primary purpose of serving our eyes with their essential partner — Light. Our eyes are more than essential tools for seeing. They are windows through which impressions come and knowledge lingers. Thus, the joy of living is enhanced.

So it is with windows used wisely and adequately. They let light in and they let the spirit out. No interior is a prison in the full sense if it has windows which let vision out. As our eyes are windows of the soul, windows are the eyes of our artificial interior world of civilization.

Through a Window

At a window in my home I survey the landscape, contemplating it in terms of a major part of a lifetime spent — with rare good fortune — in the over-

whelmingly important realms and relationships of light and color, vision and seeing. Out there the life-blood of Nature — sunlight — drenches the multitude of living things.

In my imagination I travel backward along the pathway of time, not merely a million years since civilization began, but a billion years or so to the beginning of life on earth. Probably the earth did detach itself from the sun. Being very much smaller it cooled to the point that life could exist on it while the sun remained hot.

Although the earth escaped from the sun, living things remained enslaved by it. Sunlight became the most important environmental factor under which life on earth evolved. Living things need the heat and life-giving magic of solar energy which is truly the life-blood of Nature. But this is not all or the end of the story of life.

As simple living organisms evolved into more complex ones various senses evolved, or as the scientist expresses it, certain senses became differentiated. In a billion years, more or less, evolution for certain

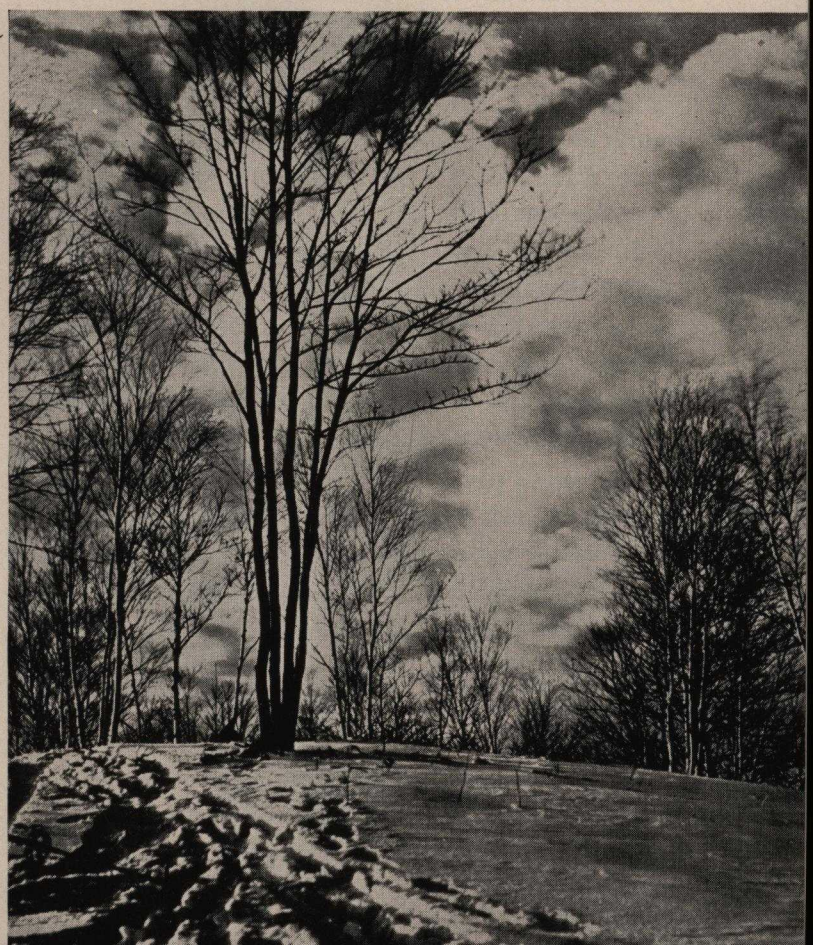
needs and adaptation to environment gave to us human beings our five major senses varying in their ranges of effectiveness.

Touch and taste tell us something of the relatively small world within reach or with which we can make actual contact. Even smell requires contact with a minute part of a material something emitted by the object. Obviously the distances spanned by these three senses are very limited. Hearing has a greater range but it requires a material medium, such as air or metal connecting us with more distant objects, and, therefore, is of relatively limited range.

Vision has no such limitations. It can span inconceivable distances out into the infinitude of celestial space where sound waves cannot even travel. All that our eyes need is light or, more strictly, radiant energy, which in itself is invisible. Such energy travels through space from the sun and from the far more distant boundaries of our universe. But this is not the limit for vision spans the almost infinite distances of other universes.

As I sit at a window a pattern of light and color

"As I sit at a window a pattern of light and color flows continually from the outdoor scene to my eyes . . . It is always changing from the dawn throughout the day and night . . . delicate melodies of light and shadow . . . the symphonies of sunset colors, the mighty dramas of winds and clouds, the majestic parade of seasons. Sunlight, rain, sleet and snow come to us through our eyes—and through windows."—Luckiesh.





Picture Windows "speak for themselves," as so well demonstrated in this illustration of a living room in a residence at Denver, Colorado. Architect: Burnham Hoyt.

flows continually from the outdoor scene to my eyes. It is invisible until it is rendered into sensation by the magic of my visual sense.

The same is true of indoor scenes but the outdoor one is never monotonous. It is always changing from dawn throughout the day and night. Over all is the blue sky with drifting clouds.

In an hour or two Nature may pass through many moods depending upon the sky. The clouds thicken and a frown spreads over the countenance of Nature. A storm approaches and soon rain beats on the windowpanes. The protection of the window enhances its importance and meaning.

The storm passes and the declining sun begins to paint the clouds for the symphony of a glorious sunset. Dusk settles and the afterglow suffuses the sky. Stars waiting all day long begin to appear. Finally darkness falls and the sky is bejewelled.

Through the window we see the ever-changing moods of days, of nights and of seasons. We respond

to these moods for we not only see but we think and we feel. We *are* human beings. Sentiments and emotions are aroused. A sunny day puts a spring in our step and in our thoughts and attitude.

The delicate melodies of light and shadow, the symphonies of sunset colors, the mighty dramas of winds and clouds, the majestic parade of seasons with sunlight, rain, sleet and snow come to us through our eyes — and through windows.

What a variety there is, each mood or play enhancing the others! Still, do we give enough credit to windows and adequate thought in planning them? They are the windows of the soul of our homes and of most other interiors. They *are* the eyes of the material world of civilization.

Daylight—Natural and Abundant

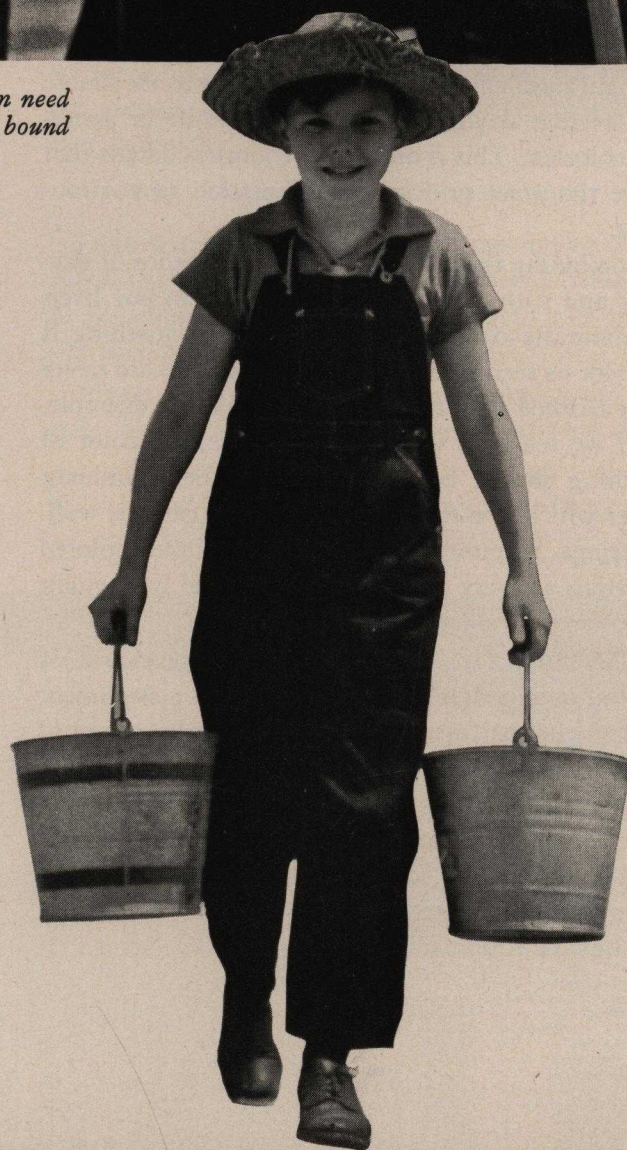
To the scientist daylight varies from the blue-white light of the cloudless sky and the white light of noon-day, to the rosy light of sunrise and sunset. However, daylight is predominantly colorless and as

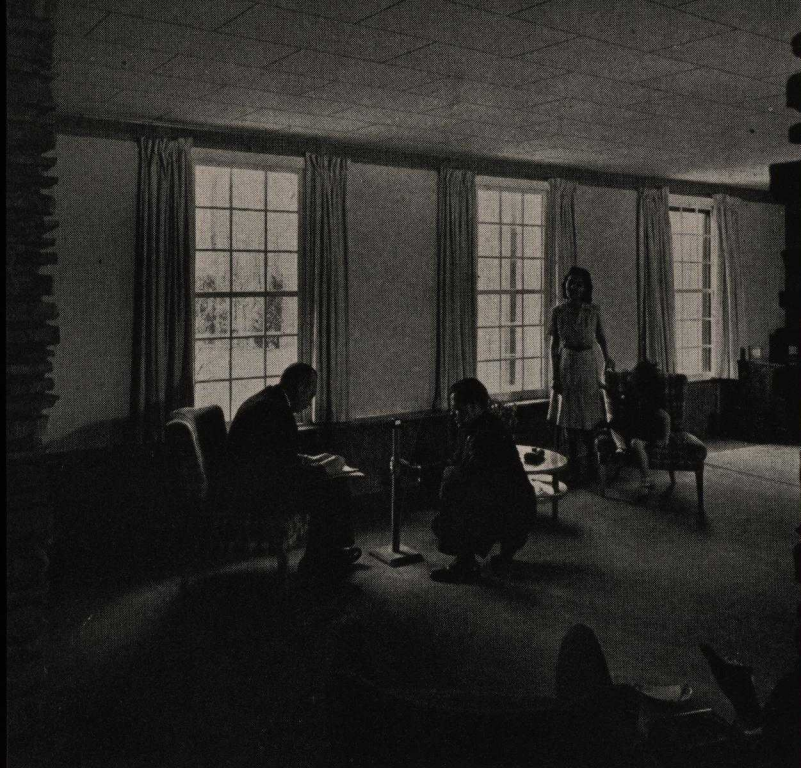


Authorities point out that men who work in the open seldom need glasses. They obtain plenty of natural light, their eyes are not bound by walls, enabling them to relax their eyes on distant views.

such has long been one of the great objectives in the production of artificial light.

It is not surprising that daylight in the course of eons of evolution of eyesight became colorless or generally so. Indeed, it would be surprising if daylight generally appeared colored to us.





Testing for adequate daylight interior illumination. A mock-up, with the regular amount of windows, left, was installed along the south wall of a Solar house in Glenview, Ill., right, and light meter readings taken. Thirty-nine footcandles of light were recorded for the room in its natural setting. After the mock-up has been put in place, requiring only five minutes, the meter showed a loss of 30 footcandles. Architect: George Fred Keck.

Our visual sense naturally evolved so as to utilize daylight most efficiently. In doing so it was inevitable that average daylight appears to be white or generally colorless. This is one of the countless details that prove the great principle of adaptation to environment.

Combining these facts with the abundance of daylight and with the influence of Nature in our lives, we naturally consider the true color of anything is its color as seen in daylight. Therefore, we are never fully satisfied as to the color of a fabric, for example, until we see it in daylight. Of course, the color of anything should be selected under the illuminant under which it is to be used. However, carpets, wall-coverings, furniture, paints and most other colored materials are very generally to be viewed in daylight some or even a major part of the time.

Therefore, daylight has become the standard or natural quality of light. It is an obvious compliment to daylight that a major trend in the production of artificial light has been toward daylight quality.

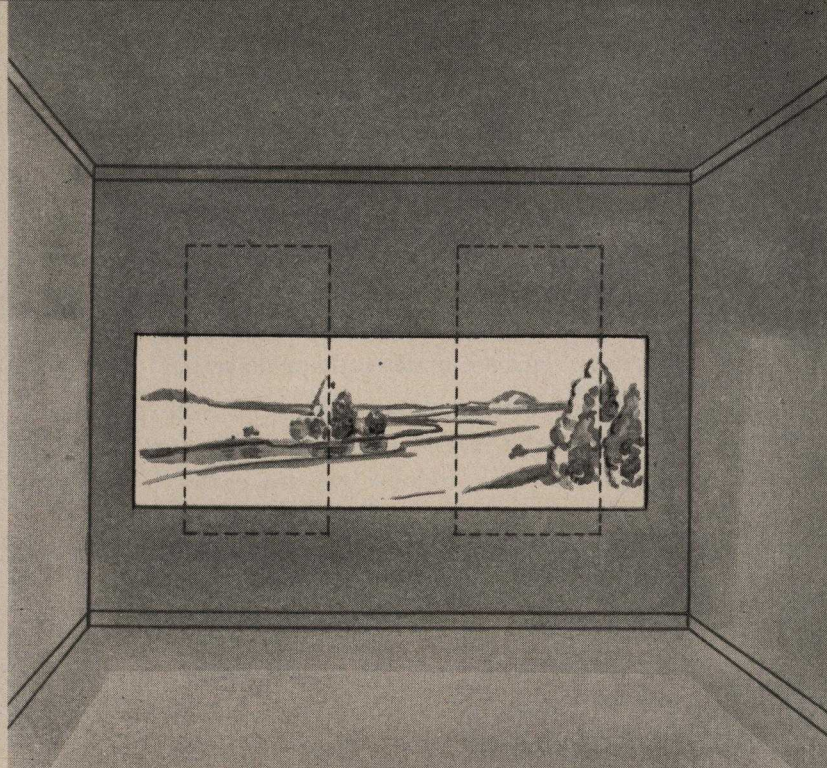
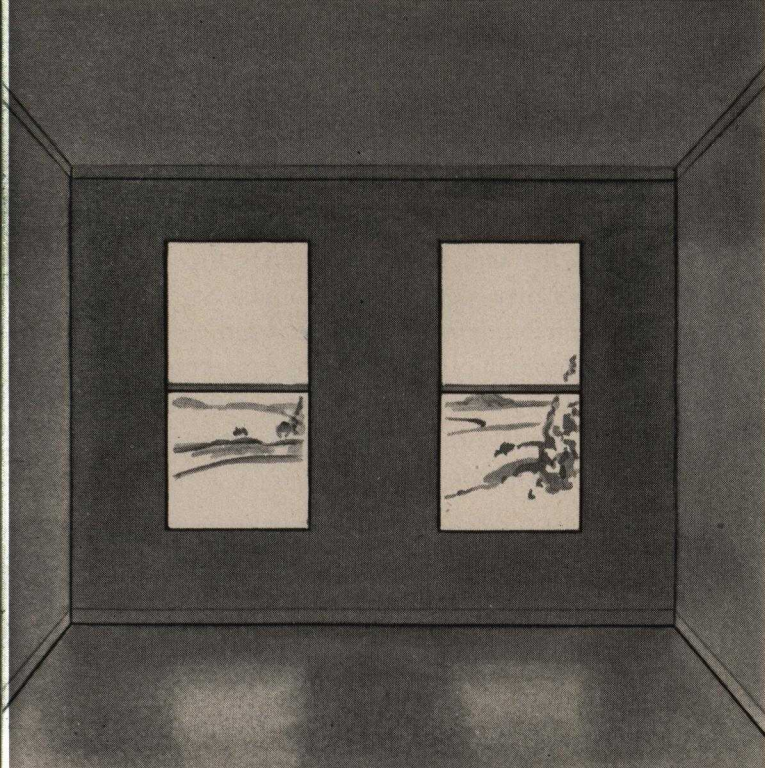
The abundance of daylight outdoors and generally near a window indoors is seldom adequately appreciated or understood. This can be simply demonstrated by means of a lighted candle and, at the same time, the unit of illumination can be roughly defined. If

this page is held vertically a foot from an ordinary candle-flame and perpendicular to a horizontal line joining it with the flame, the illumination of the page will be approximately one *footcandle*.

Imagine a thousand candles to be concentrated in the place of the single candle. At a distance of one foot the illumination on this page would be 1000 footcandles. This is the illumination at the earth's surface outdoors on a dull overcast day! Imagine that the single candle were replaced by 9000 candles. Obviously at a distance of one foot the illumination is 9000 footcandles. This is approximately the illumination at the earth's surface at noon on a clear midsummer's day.

Thus we see that outdoors, where our eyes evolve, the illumination during most of the day is measured in thousands of footcandles. Indoors near a window from which a large area of sky is visible the illumination is commonly in the range of 100 to 500 footcandles.

This is excellent for reading black print on white paper as has been adequately proved by many far-reaching researches. When the sun shines directly into a window the illumination will commonly be 2000 to 5000 footcandles depending upon its alti-



These sketches demonstrate the improvements that can be achieved by the modern design of a given window area. Ordinary windows, left, are combined—without additional glass being necessary—into a "ribbon-type" window, right. Sharp contrasts of light and dark between windows, as at left, are eliminated, reducing glare; better view is obtained and more interesting furniture groupings made possible.

tude above the horizon. This is excellent for sewing with black thread on dark goods.

These are facts readily revealed by measurements. Contrast these levels of daylight illumination with the few footcandles throughout most of the indoor areas where millions of persons spend long periods daily, throughout their lifetime, performing severe prolonged tasks of critical seeing. The indoor world is relatively a dungeon. It has its obvious advantages but through ignorance and neglect in providing adequate light, the burdens upon human eyes have greatly increased during an era which has greatly

reduced the burdens upon human backs. Millions of overburdened eyes plead for relief from the primitive dimness of the past but few of us understand their language.

Man-Made World of Near-Vision

From the viewpoint of eye-work our indoor world differs markedly from the outdoor world bathed in an abundance of daylight. Outdoor activities generally involve distant vision.

When our eyes are focused upon objects ten feet away the strain upon the eye-muscles is very much

Interesting use of Picture Window idea in window wall form. Better lighted interior, more cheerful, good view. Architect H. W. Johanson.

Window wall idea with use of translucent pattern glass. Plenty of daylight admitted, but privacy attained, or an undesirable view is shut out. Architect: Samuel Glaser.



less than when reading this page at the common distance of fourteen inches. When our eyes are focused upon objects more than twenty feet away they are generally completely relaxed. At least the muscles of accommodation which control the thickness or power of the eye-lens are under little or no strain.

Similarly the muscles which converge the two eyes upon the object are subjected to a minimum strain. However, indoors we are enslaved by the shackles of near vision. All the eye-muscles are under strain and meager light adds to the burden.

A powerful influence upon civilized progress has been man's development of tools and of skill with his hands. This produced a new world of critical tasks of seeing within arm's reach. The invention of printing eventually drafts nearly all civilized beings into the great army of readers.

Children six years of age are inducted and the service is for the duration — of life. Countless other practices and achievements have shackled the eyes to the severe prolonged strains of performing these countless tasks of critical seeing within arm's reach.

All this unnatural prolonged eye-work takes place in the restricted light of our artificial interior world. All this takes place in the greatly restricted light of this man-made world where with relatively few ex-

ceptions the nearest approach to adequate light is to be found near windows admitting light from a large expanse of sky. To one who understands the language of the eyes they plead for more light, for any aid in easing their burdens. In this age when motors are fitted to the mechanical tasks for the conservation of human energy, light should be fitted to the visual tasks for the conservation of eyesight wasted in unnecessarily burdensome seeing.

Appalling Eye-Defectiveness

Statistics pertaining to defective eyesight and to eyestrain disorders are available in great volume. All surveys reveal facts which should be appalling to everyone. Eye-defects increase in number and in degree as children advance from grade to grade. When they graduate from high school at least one out of every four needs a pair of eyeglasses.

Even a greater percentage has visual defects or disorders. Four years later one out of every three on graduating from college needs a pair of eyeglasses. These facts are the more appalling in that ninety-five per cent of these children entered the primary grade with so-called normal vision.

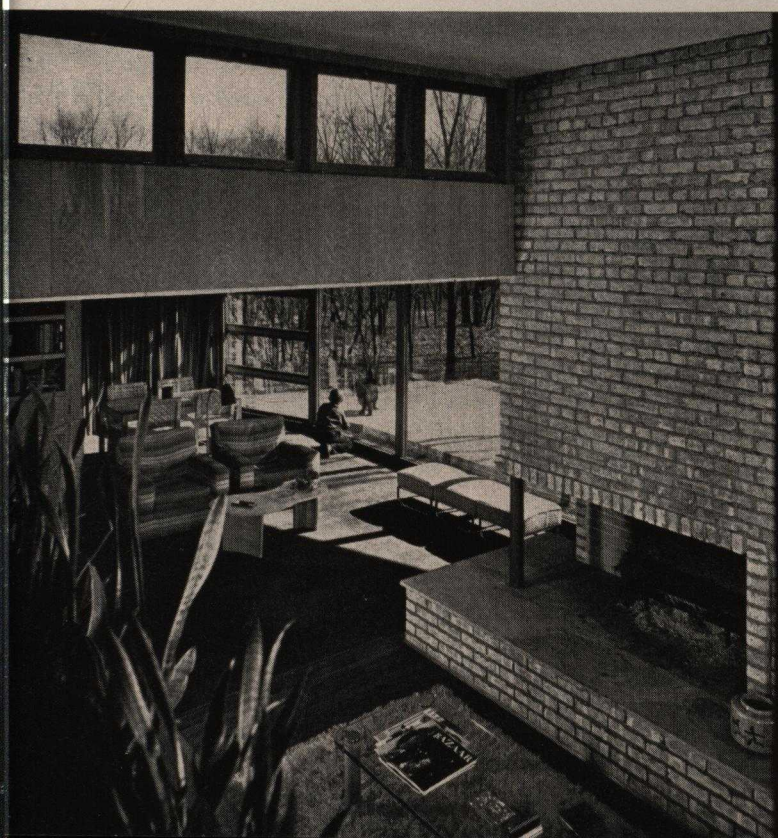
In a recent careful investigation of all the pupils in the fifth grade of a large school, forty-three per cent reported ocular discomfort and inability to see

Trends in daylighting class rooms. Window wall, left, is augmented by a glass partition, background, and window wall beyond—with high ribbon windows, right, bringing in light from the north sky. Rugen school, Glenview, Ill. Architects: Perkins, Wheeler & Will.





Three excellent examples of clerestory window treatments. Above, clerestory windows at left and right. Architect: George Fred Keck. Lower left, clerestory windows to permit light for unusually large living room, with Solar-type south window wall. Added light by clerestory provided for stairway, from where picture was taken, and fireplace area. (House is partially two stories.) Architect: Fred Purdy. Lower right: windows above and below cabinets for better light and vision in kitchen. Architect: Keck.



well at all working distances. Twenty-eight per cent complained of headaches, eyeaches, blurred vision, tearing and other typical results of eyestrain. These were ten-year-old children in an average urban community.

Surveys also reveal that eye-defects and eyestrain disorders vary markedly with the occupation. They increase decidedly from outdoor activities to indoor critical seeing. For example, in a survey among garment workers, seventy-eight per cent were found to have defective eyesight or eyestrain troubles. Among farmers about twenty per cent are so afflicted. Twenty-five million persons in this country wear eyeglasses. Another twenty-five million also need these eye-crutches.

In this age when preventive medicine, preservation of health and conservation of human resources are in the ascendency, we can scarcely view these facts calmly. Certainly we shall not accept these increases in percentage and degree of defective eyesight as being inevitable.

Certainly there is emphatic evidence that eyes are overburdened and abused and insufficient attention has been given to making seeing easier through adequate light, proper lighting and other controllable aids. But an awakening is taking place which welcomes the new luminous era.

To one who has spent decades along the frontiers of light, vision and seeing, the abuses of eyes and the inadequacy of lighting are obvious almost everywhere. I have adequate reasons for asserting that if from the age of five years children did their reading and performed their other tasks of near-vision in the abundant light of a window in the daytime, there would be fewer wearing or needing eyeglasses when they finished school.

The same facts and logic apply to adults who use and abuse their eyes daily for long periods. Eyeglasses are excellent crutches for the appallingly large percentage of eyes that need them. They do not eliminate the abuses and causes which probably contributed to the need for them. They are not primarily a preventive measure.

Notwithstanding the enormous progress in the production and use of artificial light during recent years, the daylight available indoors near windows from which a large area of sky is visible is generally

by far the nearest approach to adequate light in our indoor world. Simple measurements with a light-meter will reveal this fact in homes, in schools and throughout the work-world where daylight is available from a reasonable area of sky through clean windows of reasonable size.

Until recently artificial light was erroneously considered to be a competitor of darkness. During recent years the science of seeing has revealed that its goal is to be as adequate as daylight outdoors, depending, of course, upon the specific task of critical seeing. That is generally a far-off goal. Actually, artificial illumination is generally far less than daylight illumination indoors near most windows.

Windows in the Home

Many things conspire to make a house a home. We can make it a place of enlightenment where vision, imagination and the human spirit are freed—or we can confine these in a dingy prison. If we will, we can cast off the shackles of habit, tradition and indifference as we have replaced bare necessity and drudgery with convenience and comfort.

Windows planned with full understanding of their meaning and service can do much for us and for our home. When darkness comes, artificial light serves vision by illuminating the tasks and the interiors. It can add charm and give us a feeling of independence from darkness. In the daytime windows can do all this—and more.

Only the fortunate few can plan a dream-home and place it on a dream-site. However, all of us can fit a home and a site together so as to achieve the best result. In considering a site we can note the points of the compass. In our mind's eye we can follow the daily course of the sun in the summer sky and the winter sky. We can ascertain whether our dream-home can be so oriented that we may enjoy the full services of major windows.

We can ask ourselves questions. Can we see our rightful share of the continuous parade of Nature's moods and days and seasons? Can we look out of our major windows upon an interesting garden of our own making? Every home should have some of this. All sites can have something of our own making—an outdoor setting with its continual variety relieving the monotony of interior settings.



Dramatic fusing of the indoors and out is accomplished by Architect Edward D. Stone in this Solar-type dwelling in Old Westbury, Long Island. Note the roof extension to protect against direct summer sun rays. Glass areas fixed except for ventilating louvres at left.

We need only to turn our backs on the street and have major windows where we control the exterior settings and where Nature furnishes the canopy. Nature's shifting lights and shadows and colors are the players on this stage visible through the magic of vision — and glass.

The sun moves from window to window, but the sky is always present. It is the ever-present light-source in considering the light which comes through a window. The amount of light reaching a given point in an interior depends upon the area of sky visible from that point.

Obviously, the importance of the upper half of a window is in letting light in. The importance of the lower half is in letting vision out. By separating these two functions, the problem of planning windows is immediately simplified.

In the living room, what is a major window? Certainly in the new era of luminosity it is not the scanty left-over after the age-long battle with wall-space. Times have changed. Furniture and furnishings have changed. The useless what-not and the bookcase are not worth the sacrifice in window area.

A revolution is taking place. An entire wall of a

living room may be of glass. Living is expanded, not confined by wall spaces. Functional furniture and built-in shelves in heretofore wasted space make large glass areas possible. They may even turn a corner for added light and interest.

A major window on only one side of a room may be inadequate to achieve a luminous interior. If through necessity this is true, additional glass area may be added to the upper portion of another wall without a further sacrifice of wall space. Such windows supply light and add luminosity to the remainder of the room.

Obviously light-colored walls and ceiling and woodwork also aid materially in producing a luminous interior which is always necessary in making windows pleasant and comfortable light-sources. A dark-paneled room with a major window-area on one side can never be entirely satisfactory.

Architects who have become freed from tradition and are on the alert for new materials are achieving charming results with translucent glasses where circumstances rule against letting vision out upon an undesirable scene. They are using these in interesting ways in modern cottages in places where it is undesirable to let vision in.

The orientation of a house to the proper exposure is obviously important if one is to take advantage of sunlight in winter. This is of great psychological importance, particularly in winter. It is also of practical importance in the utilization of solar energy. Glass is transparent to the light and to most of the accompanying radiant energy. That which is absorbed in the interior heats the interior. Little of it can escape through the glass because the re-radiated energy is of long wave-lengths to which the glass is opaque. Hence, we have the so-called hot-house effect.

With the new double-pane windows the matter becomes one of engineering, of orientation, of construction, of heating and even of air-conditioning. The architect alert to these new products and to these new refinements in home-building is capable of proper design.

The householder need only to awaken to these possibilities and to demand that his home be one befitting of the new luminous era — one that receives the full services of windows. There is no more enjoy-

able place in the home throughout the seasons than a major window designed to serve human needs of vision and of vista—a mark of an enlightened era.

Windows in the School

When our children go to school for the first time they enter the slavery of near-vision — of performing visual tasks within arm's reach. Their eyes are immature in growth and in function. They need the services of adequate light and proper lighting.

Fortunately, the architecture of schools has received skilled attention for many years. There are still compromises between costs and construction, and there is still room for improvements in the use of glass areas to contribute to the objective of child health and welfare.

Economies in construction early led to unilateral lighting in classrooms; that is, by means of windows on one side of the room. Long ago the minimum window area was specified to be twenty-five per cent of the floor area. Furthermore, it was recognized that the windows should extend upward nearly to the ceiling in recognition of the much greater effectiveness of the upper part of the window in lighting the opposite side of the room. As a further guarantee of appreciable light at all desks, a certain area of sky had to be visible from every desk.

Long ago I sat on a school-lighting committee which incorporated such specifications in a code. In recognition of the much greater value of the upper portion of the window, a suggestion was made with all seriousness to spread the required glass area continuously across the upper wall and eliminate it in the lower half of the conventional windows.

This would also eliminate some of the criticism not uncommonly directed to the lower portion of the conventional windows. Indeed, the result would be a well-lighted room — and a prison. What an environment for children in their formative, impressionistic years! It would be suitable for a single-purpose, state-controlled people, but not for a land of liberty.

Experiences such as this emphasize problems of daylighting schools. Notwithstanding the study which has been given to the daylighting of classrooms, there is still room for the ingenious pioneer. The lack of perfection of unilateral lighting has long been recognized.

Shades that can be pulled down from the top to temper the sunlight, at the same time eclipse the most useful portion of the sky. Two shades in the middle of the window perform the function better, but are not generally considered practicable. Venetian blinds are a better solution of the lighting and

unilateral lighting, there is a growing suspicion that this lack of symmetry in brightness produces a lack of symmetry in the child exposed to it for long periods. Problems of posture, with its possible far-reaching effects, arise. As a consequence, in many classrooms the desks are arranged in diagonal rows so



Vast walls of glass flood this factory for fine daytime illumination, and workers can relax their eyes by looking outside—at a distance, resting eyes from "close" work by seeing a variety of colors and variously shaped objects. Designer: Albert Kahn, Associated Architects and Engineers, Inc.

glare problem. But why not large vertical louvers, controllable in position? In sunny tropical and subtropical regions perhaps large permanent louvers of structural material properly positioned are worth studying. The problem is to admit a good deal of light while tempering direct sunlight and controlling the glare from a bright sky.

Besides the glare which is sometimes present in

that the windows are no longer strictly at one side of the child.

These and other factors, combined with a growing consciousness of adequate light and proper lighting in easing the burdens upon eyesight, are leading some school authorities to the consideration of bilateral lighting.

Even single-story classrooms with well designed

roof skylights are being considered in some quarters. Thus it is seen that even where daylighting has been seriously studied for many years, as it has been in school buildings, the design of daylighting is receiving renewed attention.

Certainly ingenuity, combined with the courage to pioneer in refinement, finds opportunity here as elsewhere. And any effort appears worth while when we think of the unnatural burdens of prolonged near-vision with which civilization shackles us and our children.

Anyone who fails to appreciate the need for progress toward adequate light and perfect lighting should contemplate the high school graduating class—at least one out of every four wearing or needing eyeglasses. Nearly all these children entered school with reasonably normal vision. We are the trustees of their eyesight. Are we to be satisfied that we have done all we can do to ease the burdens upon the eyes of school children?

Windows Elsewhere

In the industrial world a considerable variety of windows and skylights has been designed and is in existence. Here we have the added problems of large floor areas and multi-story buildings. Narrow buildings in non-congested areas are well served with win-

dows on all sides. Single-story buildings can be well served by saw-tooth roofs and other types of skylights.

For years new industrial buildings have been constructed with great areas of glass. The problems and conditions are so varied that individual cases must be discussed specifically. This is not the purpose of the present discussion which is confined to the major principles and services and with the full meaning of windows.

The same is true of other buildings. In most of their exteriors and interiors the new buildings exhibit the characteristics of a new luminous era. New attention is being given to windows and other glass areas in most modern designs.

There are always exceptional cases due to needs and to conditions beyond control. In these cases modern artificial light serves wherever and whenever it is needed to augment natural illumination or when darkness comes. The new era of luminosity is also reflected in artificial lighting where in the best modern practice a great awakening has taken place. It too is in step with this age of enlightenment. Artificial light illuminates the tasks and the interiors. Windows serve in this manner—and also let vision out. Step by step they have made our artificial world of civilization possible, endurable, and enjoyable.



BOOKS *by* MATTHEW LUCKIESH, D. Sc., D. E.

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" . . . Out of windows we walk onto lawns in summer and meet men and women, and in winter windows are drums for the splendid music of storms that makes us feel so masterly 'round our fires. But for the windows, we should have to go out-of-doors to see the daylight. And the sun, which they serve, I know of nothing so beneficent as windows. Fie upon the ungrateful man who has no window-god in his house, and thinks himself too great a philosopher to bow down to windows. May he live in a place without windows for awhile to teach him the value of windows. As for me, I will keep the high worship of windows till I come to a windowless grave." . . . *Hilaire Belloc.*



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